promptly when it is needed, that there is no good excuse for the slowness in restoring normal conditions when an alarm is sounded. Another thing we have learned to be careful about is blowing off a flush gate at a greater rate than the sewer will receive the water. Damages by flooded cellars, due to water backing up through a sewer, are to be avoided. Not only are the parties injured subject to needless inconvenience, but the water department is criticised in a way that raises blisters. Where a main is 16 inches or more in diameter, it is necessary to have a number of hydrants open simultaneously to do the flushing well, and in such cases attention must be paid to the effect of the water on the street pavements. Under some conditions pavements and gutters might be injured badly if precautions against it were not taken in advance. Finally, our experience with flushing indicates that where considerable deposit must be washed out there is likely to be some clogging of meters after the work is done.

This is an outline of our methods. We have developed them through a long period until they meet our local needs. But there may be other methods which will please us better, and therefore the writer hopes that superintendents will write to the editor of the JOURNAL about them, in order that all members may have the benefit of the information. Anybody who has tried to find printed information on flushing does not need to be told that technical literature is practically silent on the subject.

WILLIAM MOLIS.

SCIENTIFIC CONTROL OF WATER SUPPLIES

At a recent gathering of public officials there was a fairly general agreement that technical matters could not be made of popular interest. The writer does not agree with this view and these notes are offered in support of his opinion.

The conspicuous features of a water-works system, the imposing dams, busy pumping stations and lofty water towers, draw public attention to the need of engineering talent in connection with such public works. The enormous retail business conducted by a water department or company, the most important business in a city, of which everyone is a customer, is gradually coming to be recognized by intelligent citizens as something that should be intrusted only to able business men. But there is practically no public appreci-

ation as yet of the need of safeguarding the quality of water by proper laboratory tests and the enforcement of suitable sanitary regulations. Only when an epidemic of typhoid fever or dysentery calls attention to the danger of neglect of sanitation is any thought given to the subject or any willingness shown to appropriate the small sums needed for sanitary supervision of the supply.

This is not surprising when all the facts are considered. The average man or woman is apprehensive only of a tangible danger in the water, something he or she can sense. An odor will cause protests; unusual tastes will cause strong complaints. But neither the protests nor complaints equal the uproar caused in the Atlantic seaside resorts a few summers ago by the presence of a few sharks. They were not the huge man-eaters of the tropical seas but fish rarely over 8 feet long. They killed a few persons, a very few, yet everybody was scared because from early childhood the ferocity of the shark has been common knowledge. Yet the shark is as harmless as a cooing dove compared with a little plant which kills its thousands annually in our American cities without any real public appreciation of its dangerous character. This plant is so small that it is measured in microns or thousandths of a millimeter. It would take about a million of them placed end to end to approximate the length of an 8-foot shark of the kind that caused would-be sea-bathers to content themselves with tubs a few years ago, yet each one of these million little plants is as dangerous to human life as a shark.

This little plant, the Bacillus typhosus, is so very minute that it is practically incomprehensible to the average man. When he is told that he must spend money to protect the water he drinks from infection by them he is inclined to class the advice as good—but not to be followed just now. But let a few dog fish show their triangular fins in the bay where he bathes on hot summer days, and immediate action is vociferously demanded. If he really knew the relative danger of the two sources of peril, he would urge his friends to help him secure adequate sanitary control of the water supply at once, and let the shark scare bother others.

Fortunately the large cities are beginning to realize the danger of Bacillus typhosus to the community. They are becoming cognizant of the help that science can give in checking and often in preventing unpleasant odors and tastes in water. Water works managers are learning that the laboratory is often able to point out possibilities of saving sums of money which sometimes amount to a

large proportion of the expense of such scientific assistance. Properly taught, through suitable publicity, the value of good continuous sanitary control of water is of real help in dealing with critical consumers. These advantages may be shown by referring briefly to what New York City is doing in safeguarding its water supplies, a subject discussed in detail in a paper presented on May 28, 1919, by Dr. Frank E. Hale before the Municipal Engineers of the City of New York, from which the following information has been obtained.

The Croton watershed is divided into 24 districts, with a sanitary inspector in each, making a daily patrol to see that no insanitary condition exists. There are five such districts in the Bronx and Byram watershed, seven in the Esopus watershed, and the Brooklyn watershed, when water is drawn from it, is put under a daily patrol system of inspection. Tap water samples in Manhattan and Brooklyn, samples from Ashokan reservoir and from a few points along the Catskill aqueduct are subject to daily bacterial and chemical examinations, as is the effluent from one of the sewage treatment plants on one of the watersheds. Other sources of supply are tested less frequently at present. Partial chemical analyses are made monthly upon all supplies, but complete chemical analyses are made weekly upon only a few representative samples. Microscopical examinations are made twice a month on the Croton reservoir and weekly on the distribution reservoirs. Other tests are made whenever needed; the supplies furnished by private water companies are analyzed monthly.

This laboratory control and the research work carried along with it enables the Department of Water Supply to furnish the best water which the existing works are capable of delivering. The advantages of storage in improving the quality of water are utilized to the utmost, and aeration of stored water is practised on a scale probably unknown elsewhere. Coagulation of the Catskill water has been investigated and whenever the regularly conducted tests show it is desirable as a working measure to improve the quality of this supply the treatment can be begun. All surface water used in New York is chlorinated before delivery to the consumer, sometimes more than once, and the chlorination is kept under constant supervision. Filtration of a very small part of the supply and the removal of iron from other small parts are watched carefully, and the operation of all stages of the processes at six sewage treatment plants

on the various watersheds is kept under constant supervision by frequent analyses. As a result of the better supervision of public sanitation generally and with these sanitary precautions the number of typhoid fever cases decreased in the period 1912–1918 as follows: Manhattan, 1389 to 554; The Bronx, 281 to 141; Brooklyn, 1358 to 453; Queens, 340 to 75; Richmond, 46 to 15. The typhoid death rate decreased during the same period as follows: Manhattan, 7.9 to 3.1; The Bronx, 4.9 to 2.6; Brooklyn, 13 to 4.0; Queens, 14.4 to 2.3; Greater New York as a whole, 9.6 to 3.3. The death rate figures in Richmond are erratic, ranging from 8.2 in 1916 to 2.2 in 1912; the 1918 rate was 5.9.

Mention has already been made of odors and tastes in water. These are investigated by the scientific staff and a great deal of practically applicable information has been obtained. Some of the trouble is due to dead ends but generally it is caused by micro-organisms. When these microörganisms are the cause, the trouble is generally foreseen and many complaints prevented. These microörganisms are minute plant and animal growths which have no known effect on the health of the consumer. Their presence is not usually noticeable until several thousand exist in every teaspoonful of water. Some of the reservoirs where these organisms develop can be by-passed, sometimes water of satisfactory quality can be drawn from some levels while that from other levels is affected. Aeration helps sometimes. Treatment with copper sulphate is a preventive in many cases but two or three days time must elapse before the water so treated is used. The one thing that experience to date has shown is that a new problem may be expected at any time during the season of growth of these organisms.

The help of the chemist and bacteriologist is essential in supplying water of really good quality to many cities. Year by year the laws governing the quality of water which may be supplied for drinking purposes are becoming more strict. Some states already make the supply of infected water a very serious matter for the officials of a water department.

JOHN M. GOODELL.